

SUPPORT FOR AMENDMENTS

Claim 1 has been amended for clarity. Support can be found in the claim as originally filed, in the specification at page 5, line 23 through page 7, line 14, original Claim 2, and in Fig. 1. Claims 9-11 have been newly added. Support can be found in the specification at points listed below:

- Claims 9 & 10: page 11, line 29 through page 12, line 1; and
- Claim 11: page 12, lines 12-16.

No new matter has been added.

REMARKS/ARGUMENTS

The present claims relate to organic electroluminescent displays comprising: i) an organic electroluminescent device; and ii) a color converting member, said color converting member comprising a shielding layer and a shielding layer aperture region comprising a color converting layer, wherein edges of the aperture region are closer to the center of the aperture region than edges of an emission region of the organic electroluminescent device, and wherein a perpendicular distance h (μm) from the shielding layer to an emitting layer of the organic electroluminescent device and a length X (μm) of an overlapping part of the shielding layer and the emission region satisfy expression (I): $X/h \geq 0.60$ (I).

The rejection of Claim 1 under 35 U.S.C. § 102(b) in view of JP 11-345688 (**JP '688**) has been obviated by amendment. Applicants note that the Examiner has rejected Claim 1 in view of the Abstract and Figures of **JP '688**. Applicants submit herewith a machine translation of **JP '688**. The cited reference contains no disclosure of organic electroluminescent displays wherein, *inter alia*, a perpendicular distance h (μm) from the shielding layer to an emitting layer of the organic electroluminescent device and a length X

(μm) of an overlapping part of the shielding layer and the emission region satisfy expression

(I): $X/h \geq 0.60$ (I) (*see* Claim 1). Accordingly, the rejection should be withdrawn.

The rejection of Claim 1-8 under 35 U.S.C. § 112, 2nd, is obviated by amendment to Claim 1. Accordingly, the rejection should be withdrawn.

Applicants submit that the above-identified application is in condition for allowance. Early notification thereof is earnestly requested.

Respectfully submitted,

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- 2.*** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention is used for home electronics, such as a display on which an information display panel, various instruments panels, an animation, and a still picture are displayed, a car, and two-wheeled vehicle electronic autoparts, and relates to the structure of the organic electroluminescence display constituted using the organic compound.

[0002]

[Description of the Prior Art]In recent years, an organic EL device is studied briskly and is being put in practical use. This uses hole carrying materials, such as triphenyldiamine (TPD), as a thin film by vacuum evaporation on transparent electrodes (hole injection electrode), such as tin doped indium oxide (ITO). With the element which has the basic constitution which furthermore laminated fluorescent substances, such as an aluminum quinolinol complex (Alq3), as a luminous layer, and formed the metal electrode (electron injection electrode) in which work functions, such as Mg, are still smaller. By several 100 to several 10000 cd/m² and very high luminosity being obtained on the voltage before and behind 10V, it is observed as a display of home electronics, a car, two-wheeled vehicle electronic autoparts, etc.

[0003]By the way, although various applications can be considered as a display using such an organic EL device, the application to a color display is an important technical problem especially. When applying a photogen as a color display, the technique of changing the luminescent color of the photogen itself or, for example, acquiring blue, green, and a red 3 yuan color using a light filter is common. As a trial to which the luminescent color of the photogen itself is changed, for example, -- . SID. 96 . DIGEST and 185 14.2:Novel Transparent Organic Electroluminescent Devices G.Gu,V.BBulovic,P.E.Burrows,S.RForrest,M.E.Tompson. As a color luminescence element boiled and indicated, what used Ag and a Mg thin film for the cathode, and used ITO for the positive electrode is known. However, the color luminescence element (heterostructure organic light emitting devices) indicated here, It is the multilayer structure which has R, G, and a luminous layer (Red ETL, Green ETL, Blue ETL) corresponding to B of each.

There is a problem that a cathode and a positive electrode must be prepared for every luminous layer, structure becomes complicated, and a manufacturing cost also becomes high.

Since the lives of each color differ, there is also inconvenience that color balance collapses as it is used.

[0004]On the other hand, when considering it as a multicolor display combining a single luminous layer and light filter, a color filter layer and an organic electroluminescence structure will usually be provided on the same board. however, forming a color filter layer and providing an organic electroluminescence structure further on a substrate, produces the exfoliation phenomenon boiled and depended on the difference in the stress in the ITO thin film which is a hole injection electrode, and a coefficient of thermal expansion with a color filter layer, and difficult work follows.

[0005]It is also an important technical problem to raise the display quality which is the characteristic of a display. In order to raise display quality, the permeability in the light range conventionally called a black matrix had provided the low layer in the display surface of the display, etc. Also when providing this black matrix, difficult work is required for the too same reason as the above-mentioned light filter. For this reason, a means in which display quality is raised and it deals by a easier method is desired.

[0006]

[Problem(s) to be Solved by the Invention]The purpose of this invention does not need a complicated

structure by a multicolor type, either, but the work of manufacture, lamination, etc. is easy for it, and there are few damages to an organic electroluminescence structure, and it is realizing the organic electroluminescence display of low cost.

[0007]It is providing the good organic electroluminescence color display of display quality.

[0008]

[Means for Solving the Problem]The above-mentioned purpose is attained by following this invention.

(1) An organic electroluminescence structure which has a hole injection electrode, an electron injection electrode, and one or more sorts of organic layers that participate in a luminescence function inter-electrode [these] is the organic electroluminescence display currently formed on a substrate, An organic electroluminescence display which has a color filter layer in a field which said substrate is an optical extraction side, and an auxiliary substrate is arranged in an organic electroluminescence structure film formation surface and an opposite hand of this substrate, and counters with said substrate of this auxiliary substrate.

(2) An organic electroluminescence display of the above (1) by which said auxiliary substrate has a black matrix layer for correcting an angle of visibility further, and a hole injection electrode of said organic electroluminescence structure is formed also to a field in which an auxiliary electrode layer is formed.

(3) An organic electroluminescence structure which has a hole injection electrode, an electron injection electrode, and one or more sorts of organic layers that participate in a luminescence function inter-electrode [these] is the organic electroluminescence display currently formed on a substrate, An organic electroluminescence display which has a black matrix layer in a field which an auxiliary substrate is arranged in an organic electroluminescence structure film formation surface and an opposite hand of said substrate, and counters with said substrate of this auxiliary substrate.

(4) An organic electroluminescence display of the above (3) by which a hole injection electrode of said organic electroluminescence structure is formed also to a field in which an auxiliary electrode layer is formed.

(5) An organic electroluminescence display of the above (4) in which said auxiliary substrate has a color filter layer.

[0009]

[Embodiment of the Invention]Hereafter, the concrete composition of this invention is explained in detail.

The organic electroluminescence color display of this invention A hole injection electrode and an electron injection electrode, The organic electroluminescence structure which has one or more sorts of organic layers which participate in a luminescence function inter-electrode [these] is the organic electroluminescence display currently formed on the substrate, Said substrate is an optical extraction side and it is a display of the multicolor type which has a color filter layer in the field which an auxiliary substrate is arranged in the organic electroluminescence structure film formation surface and opposite hand of this substrate, and counters with said substrate of this auxiliary substrate.

[0010]Thus, by being, carrying out, providing a translucent auxiliary substrate, and providing a color filter layer in the substrate of this auxiliary substrate and the field which counters transparent to a field opposite to the organic electroluminescence structure of a substrate, The commutative damage of a light filter and an organic electroluminescence structure can be prevented, it becomes easy [handling], and a light filter can be produced with very easy composition.

[0011]As for the color filter layer arranged at an auxiliary substrate, it is preferred to use one or more sorts of a blue filter layer, a green filter layer, and a red filter layer. What is necessary is to prepare the characteristic of a light filter according to the light in which organic electroluminescence emits light, and just to optimize extraction efficiency and color purity, although the light filter used with the liquid crystal display etc. may be used for a color filter layer. It is preferred to use the light filter which can cut the light of short wavelength in which the fluorescence conversion layer provided by an EL element material or necessity carries out optical absorption.

[0012]When making a full color display profitably like using such a light filter, the color after light filter passage should just adjust to the chromaticity coordinate of an NTSC standard or the present CRT. Such a chromaticity coordinate can be measured using a common chromaticity coordinate measuring instrument, for example, BM-7 by TOPCON CORP., and SR-1 grade.

[0013]Although the thickness in particular of a color filter layer is not limited, what is necessary is just

usually about 0.2–20 micrometers.

[0014]It is good as for instead of a light filter using an optical thin film like a derivative multilayer film.

[0015]What is necessary is for a color filter layer to adjust the thing of required color, and just to use it in the full color display by three-primary-colors display, when using for other character displays etc. using the above blue and a green and red thing.

[0016]The fluorescence conversion layer provided as occasion demands can be formed using a binder, a fluorescent material, and an optical absorption material, although EL luminescence is absorbed and the convert colors of the luminescent color are performed by making light emit from the fluorescent substance in a fluorescence conversion layer.

[0017]What has a high fluorescence quantum yield should just be used for a fluorescent material, and it is fundamentally desirable for absorption to be strong to an EL luminescence wavelength band. Luminescence maximum wavelength λ_{max} of a fluorescence spectrum is specifically 580–630 nm, and also when the half breadth of a light emission peak is any, the fluorescent substance which is 10–100 nm is preferred.

Actually, the coloring matter for laser, etc. are suitable and A rhodamine compound, What is necessary is just to use a perylene system compound, a cyanine system compound, a phthalocyanine system compound (subphthalocyanine etc. are included), a naphthalo imide system compound, a condensed ring hydrocarbon system compound, a condensation heterocyclic system compound, a styryl system compound, etc.

[0018]The thing of a binder that what is necessary is just to choose material which does not quench fluorescence fundamentally, and detailed patterning can be performed in photo lithography, printing, etc. is preferred.

[0019]When the optical absorption of a fluorescent material is insufficient, it uses, but when there is no necessity, it is not necessary to use an optical absorption material. The optical absorption material should just choose material which does not quench the fluorescence of a fluorescent material.

[0020]By using such a fluorescence conversion filter, desirable x and y value are obtained in a CIE chromaticity coordinate. Although what is necessary is just to adjust the thickness of a fluorescence conversion layer suitably according to luminescence at that time, what is necessary is just usually about 2–50 micrometers.

[0021]When it does not have a black matrix, it is preferred to make it larger than the size of a pixel to such an extent that the size of a light filter or a fluorescence filter can secure an angle of visibility. When it has a black matrix, it does not necessarily need to be equal to the size of a pixel, and as long as it is a size which covers all the openings of a black matrix, it may be larger than a pixel or may be small. About 0.5–10 micrometers of the thickness is about 1–5 micrometers more preferably.

[0022]As a method of forming a color filter layer, it can form by printing of a screen method etc., the photoresist containing paints, etc. When forming by the photoresist containing paints, after applying the photoresist of predetermined thickness entering paints and forming with a spin coat etc. on a substrate, prebake is performed as occasion demands. Subsequently, the pattern of a photo mask is adjusted to a position, it irradiates with ultraviolet rays etc., they are exposed and developed, and a pattern is obtained. Postbake can be performed as occasion demands and the filter layer of a prescribed pattern can be obtained.

[0023]Since both become the optical extraction side as a material of a substrate and an auxiliary substrate, the transparent thing which have a light transmittance state and for which it is, and it carries out and a translucent material is used is required. As for a light transmittance state, it says here a luminous wavelength zone and that 350–800 nm of light transmittance in a light range is usually not less than 80% not less than 70% especially preferably especially not less than 50%. It can decide suitably according to an organic electroluminescence structure, construction material of a filter layer, etc. which are specifically laminated. For example, thermoplastics, such as thermosetting resin, such as transparency of glass, quartz, resin, etc. thru/or a translucent material, and phenol resin, and polycarbonate, etc. can be used.

[0024]As for especially the thickness especially of about 0.5–1.1 mm and an auxiliary substrate, as thickness of a substrate, about 0.5–1.1 mm is preferred about 0.3–3 mm about 0.3–3 mm.

[0025]After an organic electroluminescence structure is laminated and a sealing plate is usually formed on a substrate, the auxiliary substrate in which the filter layer was formed is stuck on them, as a filter layer and a substrate counter the organic electroluminescence structure film formation surface of this substrate, and the field of an opposite hand. Adhesives are used for lamination.

[0026]As adhesives, can maintain the stable adhesive strength, and a filter layer is corroded, or what does not have on translucency is preferred. Especially if such, it is not limited, but it is preferred to use cation hardening type ultraviolet curing type epoxy resin adhesive and anaerobic adhesives.

[0027]The organic electroluminescence display of this invention may have a black layer called a black matrix to the substrate of an auxiliary substrate, and the field which counters.

[0028]By providing a black matrix layer, interference of the light between each pixel and reflection of outdoor daylight can be prevented, the display quality of a display can improve, and an angle of visibility can be corrected appropriately.

[0029]If a black matrix layer is a black layer, the construction material in particular is not regulated, but pigment dispersion [, such as carbon black,] type resist, the color pile of a light filter, chromium, low reflection chromium, etc. are usually used.

[0030]The formation method of a black matrix layer should just also apply to the above-mentioned filter layer. It can form also with a sputtering technique or vacuum deposition.

[0031]A black matrix layer is arranged at the nonluminescent portion (portions other than a pixel) of a display, and raises image quality by covering the circumference of a pixel in a black layer. The size of the portion (a window part is called below), alias a wrap, which makes luminescent light penetrate that there is nothing does not necessarily need to be the same as that of a pixel at a black matrix layer. For example, as shown in drawing 2, it may arrange so that the window part 7 may become narrow to the pixel 2, and it may arrange so that the window part 7 may become large to the pixel 2, as shown in drawing 3. These relations are not prescribed by only the size of the window part of a black matrix, and are decided with the relation between relative relationship with the size of a picture element part, an angle of visibility, and the thickness of a substrate, etc.

[0032]That is, in the case of drawing 2, pixel (organic EL device) 2 portion is comparatively large, and makes the window part 7 of a black matrix smaller than this pixel 2 portion. The angle of visibility in this case is regulated by the window part which is on the diagonal line from the end of a pixel, respectively. In the case of drawing 3, pixel (organic EL device) 2 portion is comparatively small, and makes the window part 7 of a black matrix larger than this picture element part. The angle of visibility in this case is regulated by the end of the window part 7 which is on the radiation from the end of a pixel, respectively.

[0033]What is necessary is just to adjust such physical relationship suitably for every pixel so that it may become the optimal with the specification of a display, etc. In the case of drawing 2, the pixel pattern distinctly carried out by the black matrix is obtained, but although it is a big screen therefore, pixels approach, and it becomes difficult to get about high density and a highly minute screen, and becomes easy to produce restrictions in internal structures, such as wiring of an electrode, and a drive circuit. Therefore, it can be said that it is suitable for the display of a segment type with few comparatively near things, etc.

[0034]In the case of drawing 3, it is easy to secure an angle of visibility, the extraction efficiency of part luminescent light with the large window part 7 is good, and a display design is also easy. However, between the projection portion of the black matrix 6, i.e., the portion hidden by the black matrix 6, and the organic electroluminescence structure 2 used as a luminous region, it will have the predetermined field (crevice) g. That is, in this field g, the auxiliary-electrode 8 grade currently formed in the nonluminescent portion is put to an extraneous light.

[0035]Since low resistance [transparent electrode / 21 / ITO], by being located near the luminous region, the auxiliary electrode 8 electrically connects the ITO transparent electrode 21, and has an effect which prevents the brightness unevenness by the voltage drop to a light-emitting part. The defect by leak is controlled by the fall of driver voltage, and a reliable organic electroluminescence display can be manufactured.

[0036]However, this auxiliary electrode 8 is usually formed with metal, such as aluminum, for low-resistance-izing. For this reason, reflectance is high and, in the neighborhood of a light-emitting part, the whole display quality may fall off in response to reflection of outdoor daylight.

[0037]Then, as shown, for example in drawing 5 and drawing 6, it is good to laminate, as the ITO transparent electrode 21 and the auxiliary electrode 8 lap in part. In this example, as shown in drawing 4, the auxiliary electrode 8 laps with the ITO transparent electrode 21 in part, and as it encloses this, it is formed. This overlapping portion is equivalent to said predetermined field g, or serves as a field slightly larger than this. When it sees from the substrate 1 side (display side) by doing in this way, in order that the

ITO transparent electrode 21 may achieve the duty of the antireflection film from outdoor daylight, display quality improves. That is, by making the outdoor daylight 9 reflected from the auxiliary electrode provided for low-resistance-izing interfere within the ITO transparent electrode immediately under it (in seeing from a display surface), reflectance is reduced and display quality is raised. By this laminated structure, reflection of the outdoor daylight 9 will fall and a certain amount of display quality can be maintained. A black matrix layer may be omitted in this case.

[0038]In drawing 6, after the passivation layer 22 is formed further, an organic layer etc. are laminated by the circumference of the ITO transparent electrode 21, and it goes to it. Barrier layers, such as corrosion-resistant high titanium nitride, may be provided between the ITO transparent electrode 21 and the auxiliary electrode 8 also in this case. Such a structure is suitable for the display etc. of the dot-matrix type with which the pixel which crowded comparatively is located in a line.

[0039]As construction material of an auxiliary electrode layer, although an alloy with transition elements, such as metal, such as aluminum and Au, or aluminum, Si or Sc, Nb, Zr, Hf, Nd, Ta, Cu, Cr, Mo, Mn, nickel, Pd, Pt, and W, is mentioned, aluminum and an aluminum alloy are especially preferred. As for aluminum, when using an aluminum alloy, one or more sorts of aluminum and a transition element of alloys are preferred, and it is preferred in that case more than 90at% and that it is more than 95at% especially.

[0040]Especially an auxiliary electrode layer has [below 1ohm / ** / below 0.5ohm / **] preferred sheet resistance. Although the minimum in particular is not regulated, it is usually 0.1ohm / ** grade.

[0041]As for especially the reflectance to the light of the light region of the nonluminescent part which provided the lamination portion of an auxiliary electrode layer and an ITO transparent electrode (hole injection electrode), it is preferred that it is 30% or less 80% or less.

[0042]Although the thickness in particular of an auxiliary electrode layer is not restricted, 20–1000 nm and about further 100–500 nm are especially preferably preferred 10–2000 nm.

[0043]Thus, by providing an auxiliary substrate in a field opposite to the organic electroluminescence structure of a substrate, and providing a black matrix layer in the substrate of this auxiliary substrate, and the field which counters, handling can become easy and display quality can be raised with very easy composition.

[0044]Although the example of drawing 6 has indicated the organic electroluminescence structure 2 as a structure which has the ITO transparent electrode 21, the passivation layer 22, the hole pouring transporting bed 23, the luminous layer 24, the electron injection transporting bed 25, and the electron injection electrode 26, Not the thing limited to such a structure but the hole pouring transporting bed 22 and electron injection transporting bed 24 grade may be omitted, and it is good also as a mixed layer with a luminous layer, etc. Sealing plates are omitted in a figure. Other composition is the same as that of drawing 1 – 3.

[0045]The organic EL device of this invention may provide barrier layers, such as titanium nitride (TiN), between a hole injection electrode and an auxiliary electrode. It is preferred to have sufficient etching-proof nature to etchant of an auxiliary electrode as a barrier layer, Nitrides, such as chromium, titanium nitride, molybdenum nitride, tantalum nitride, and chromium nitride, Silicide compounds, such as cobalt silicide, chromium silicide, molybdenum silicide, tungsten silicide, and titanium silicides, titanium carbide, doped carbonization silicon, etc. can be mentioned preferably. Also in these, titanium nitride and chromium have high corrosion resistance, and it is preferred. 5 to 55% may be sufficient as the rate of nitriding of titanium nitride.

[0046]As for especially the thickness of a barrier layer, 30–100 nm is preferred 5–200 nm.

[0047]Next, the organic electroluminescence structure which constitutes the organic electroluminescence display of this invention is explained.

[0048]Since a hole injection electrode is composition which takes out the light which usually emitted light from the substrate side, transparence thru/or a translucent electrode are preferred. As a transparent electrode, although ITO (tin dope indium oxide), IZO (zinc dope indium oxide), ZnO, SnO₂, and In₂O₃ etc. are mentioned, ITO (tin dope indium oxide) and IZO (zinc dope indium oxide) are preferably preferred. Although ITO usually contains In₂O₃ and SnO with stoichiometric composition, some amounts of O may be deflected after this.

[0049]As for especially a hole injection electrode, it is preferred that a luminous wavelength zone and light

transmittance [especially usually as opposed to each luminescent light 350–800 nm] are not less than 90% not less than 80%. Since luminescent light is taken out through a hole injection electrode, when the transmissivity becomes low, the luminescence from a luminous layer itself declines and there is a tendency for luminosity required as a light emitting device to no longer be obtained. However, when taking out luminescent light only from one side, what is necessary is just not less than 80% to the luminescent light of the extraction side and an opposite hand. When taking out from both sides, what is necessary is just not less than 80% to each luminescent light.

[0050]The thickness of a hole injection electrode should just have the thickness more than [which can perform hole pouring enough] fixed, and its range of 10–500 nm and further 30–300 nm is preferably preferred. Although the maximum does not have restriction in particular, if not much thick, problems, such as a fall of exfoliation, aggravation of processability, the obstacle by stress, and a light transmittance state and leak by surface granularity, will arise. Conversely, when thickness is too thin, there is a problem in respect of the film strength at the time of manufacture, or hole transport capacity and resistance.

[0051]Although this hole injection electrode layer can be formed with vacuum deposition etc., forming by a sputtering technique preferably is preferred.

[0052]As an electron injection electrode, the substance of a low work function has it and For example, K, [preferred] In order to raise metallic element simple substances, such as Li, Na, Mg, La, Ce, Ca, Sr, Ba, aluminum, Ag, In, Sn, Zn, and Zr, or stability, it is preferred to use the alloy system of two ingredients and three ingredients containing them. As an alloy system, Ag–Mg (Ag:0.1 – 50at%), aluminum–Li (Li:0.01 – 12at%), In–Mg (Mg:50 – 80at%), aluminum–Ca (Ca:0.01 – 20at%), etc. are mentioned, for example. An electron injection electrode can be formed also by vacuum deposition or a sputtering technique.

[0053]The thickness of an electron injection electrode thin film should just make electron injection the thickness more than [which can be performed enough] fixed, and should just set it to 1 nm or more preferably 0.5 nm or more. Although there is no restriction in particular in the upper limit, the thickness is just usually about 1–500 nm. On an electron injection electrode, a protection electrode may be provided further.

[0054]In order that the thickness of a protection electrode may secure electron injection efficiency and may prevent penetration of moisture, oxygen, or an organic solvent, what is necessary is just to make it into the thickness more than fixed, and its range of 100–1000 nm is especially preferably preferred not less than 100 more nm not less than 50 nm. When a protective electrode layer is too thin, the effect is not acquired, and the step coverage nature of a protective electrode layer becomes low, and connection with a terminal electrode becomes less enough. On the other hand, since the stress of a protective electrode layer will become large if a protective electrode layer is too thick, the growth rate of a dark spot will become quick.

[0055]What is necessary is just to be usually about 100–1000 nm as thickness of the whole which combined the electron injection electrode and the protection electrode, although there is no restriction in particular.

[0056]After electrode membrane formation, it may add to said protection electrode and the protective film using organic materials, such as a carbon fluoride polymer containing inorganic materials, such as SiO_x , Teflon, and chlorine, etc. may be formed. A protective film shall be transparent, or shall be opaque, and the thickness of a protective film shall be about 50–1200 nm. What is necessary is just to form a protective film by a general sputtering technique, vacuum deposition, the PECVD method, etc. besides the aforementioned reactive sputtering method.

[0057]In order to prevent oxidation of the organic layer of an element, or an electrode, it is preferred to form a sealing layer on an element. In order to prevent invasion of humidity, an adhesive resin layer is used for a sealing layer, and it pastes up and seals a sealing plate. Inactive gas of sealing gas, such as Ar, helium, and N_2 , etc. are preferred. As for the moisture content of this sealing gas, it is especially more preferably preferred that it is 1 ppm or less 10 ppm or less 100 ppm or less. Although there is no lower limit in particular in this moisture content, it is usually about 0.1 ppm.

[0058]Especially glass is preferred, although it is plate-like preferably as a material of a sealing plate and the transparence thru/or translucent material of glass, quartz, resin, etc., etc. is mentioned. Although the field of cost to alkaline glass is preferred as such a glass material, the thing of the glass composition of

soda lime glass, lead alkaline glass, borosilicate glass, aluminosilicate glass, silica glass, etc. is also preferred. A glass material without a surface treatment can use it cheaply with soda glass especially, and it is desirable. As a sealing plate, a metal plate, a plastic sheet, etc. can also be used besides a glass plate. [0059]A sealing plate may adjust height using a spacer and may hold it in desired height. As a material of a spacer, resin beads, silica beads, a glass bead, glass fiber, etc. are mentioned, and especially a glass bead etc. are preferred. Although a spacer is usually the granular material to which particle diameter was equal, as long as the shape in particular is not limited and there is no trouble in the function as a spacer, it may be various shape. As the size, a diameter in terms of the μm is 1–20 micrometers. It is 1–10 micrometers more preferably. 2–8 micrometers is especially preferred. As for the thing of such a diameter, it is preferred that they are about 100 micrometers or less of grain length, and although the minimum in particular is not regulated, it is usually about 1 micrometer.

[0060]When a crevice is formed in a sealing plate, even if it uses it, it is not necessary to use a spacer. As a desirable size in the case of using it, although said range may be sufficient, the range of 2–8 micrometers is especially preferred.

[0061]It may be beforehand mixed into the adhesives for closure, or a spacer may be mixed at the time of adhesion. the content of the spacer in the adhesives for closure -- desirable -- 0.01 – 30wt% -- it is 0.1 – 5wt% more preferably.

[0062]The stable adhesive strength can be maintained as adhesives, especially if airtightness is good, it is not limited, but it is preferred to use cation hardening type ultraviolet curing type epoxy resin adhesive.

[0063]Next, the organic layer provided in an organic EL device is described.

[0064]A luminous layer has a hole (electron hole) and electronic pouring functions, those transportation functions, and the function to make the recombination of a hole and an electron generate an exciton. An electron and a hole can be poured in and conveyed with easily and sufficient balance by using a neutral compound for a luminous layer comparatively electronically.

[0065]A hole pouring transporting bed has a function which bars the function which makes easy pouring of the hole from a hole injection electrode, the function to convey a hole stably, and an electron, and an electron injection transporting bed, It has a function which bars the function which makes easy pouring of the electron from an electron injection electrode, the function to convey an electron stably, and a hole. These layers increase – Make the hole and electron which are poured into a luminous layer shut up, make a recombination area optimize, and improve luminous efficiency.

[0066]Although the thickness of a luminous layer, the thickness of a hole pouring transporting bed, and the thickness in particular of an electron injection transporting bed are not restricted and change also with formation methods, it is usually preferred to be especially referred to as 10–300 nm about 5–500 nm.

[0067]What is necessary is just to make them into comparable as the thickness of a luminous layer or 1 / about 10 to 10 times, although the thickness of a hole pouring transporting bed and the thickness of an electron injection transporting bed are based on the design of a recombination–radiation field. As for a pouring layer, when dividing a hole, or an electronic pouring layer and transporting bed, it is preferred that 1 nm or more and a transporting bed set to 1 nm or more. The maximum of the thickness of the pouring layer at this time and a transporting bed is [in a pouring layer] usually about 500 nm at about 500 nm and a transporting bed. About such thickness, it is also the same as when providing two layers of pouring transporting beds.

[0068]The luminous layer of an organic EL device is made to contain the fluorescence substance which is a compound which has a luminescence function. At least one sort chosen from compounds, such as a compound which is indicated by JP,63–264692,A, for example, Quinacridone, rubrene, and styryl system coloring matter, as such a fluorescence substance, for example is mentioned. quinoline derivatives, such as metal complex coloring matter which makes a ligand eight quinolinols, such as tris(8–quinolinolato) aluminum, or the derivative of those, tetraphenylbutadiene, anthracene, perylene, coronene, and 12–phtalo peri -- non, a derivative etc. are mentioned. The phenyl anthracene derivative of Japanese Patent Application No. No. 110569 [six to], the tetra aryl ethene derivative of Japanese Patent Application No. No. 114456 [six to], etc. can be used.

[0069]It is preferred to use it combining the host substance which can emit light by itself, and the use as a dopant is preferred. As for the content of the compound in the luminous layer in such a case, it is preferred that it is further 0.1 – 15wt% 0.01 – 20wt%. The luminous wavelength characteristic of a host substance can

be changed by using it combining a host substance, and while luminescence which shifted to long wavelength is attained, the luminous efficiency and stability of an element improve.

[0070]As a host substance, a quinolinolato complex is preferred and the aluminium complex which makes an eight quinolinol or its derivative a ligand further is preferred. As such an aluminium complex, what is indicated by JP,63-264692,A, JP,3-255190,A, JP,5-70733,A, JP,5-258859,A, JP,6-215874,A, etc. can be mentioned.

[0071]First specifically Tris(8-quinolinolato) aluminum, bis(8-quinolinolato)magnesium, Bis(benzo [f]-8-quinolinolato)zinc, bis(2-methyl-8-quinolinolato)aluminumoxide, Tris(8-quinolinolato) indium, tris(5-methyl-8-quinolinolato) aluminum, 8-quinolinolatolithium, tris(5-chloro-8-quinolinolato) gallium, There are bis(5-chloro-8-quinolinolato)calcium, 5,7-dichloro 8-quinolinolatoaluminum, tris(5,7-dibromo-8-hydroxyquinolinolato) aluminum, poly [zinc (II)-bis(8-hydroxy-5-kino RINIRU)methane], etc.

[0072]May be other ligands an aluminium complex which it has besides an eight quinolinol or its derivative, and as such a thing, Bis(2-methyl-8-quinolinolato)(phenolate) aluminum (III), Bis(2-methyl-8-quinolinolato) (alt. crezolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(metha-crezolate)aluminum (III), bis(2-methyl-8-quinolinolato)(para-crezolate)aluminum(III) . Bis(2-methyl-8-quinolinolato)(ortho-phenylphenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(meta-phenylphenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(para-phenylphenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(2,3-dimethylphenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(2,6-dimethyl phenolate) aluminum (III) and bis(2-methyl-8-quinolinolato)(3,4-dimethyl phenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(3,5-dimethyl phenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(3,5-di-tert-butyl phenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(2,6-diphenyl phenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(2,4,6-triphenyl phenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(2,3,6-trimethyl phenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(2,3,5,6-tetramethyl phenolate) aluminum (III), Bis(2-methyl-8-quinolinolato)(1-NAFUTORATO) aluminum (III), Bis(2-methyl-8-quinolinolato)(2-NAFUTORATO) aluminum (III), Bis(2,4-dimethyl- 8-quinolinolato)(ortho-phenylphenolate) aluminum (III) and bis(2,4-dimethyl- 8-quinolinolato) (para-phenylphenolate) aluminum (III), Bis(2,4-dimethyl- 8-quinolinolato)(meta-phenylphenolate) aluminum (III), Bis(2,4-dimethyl- 8-quinolinolato)(3,5-dimethyl phenolate) aluminum (III), Bis(2,4-dimethyl- 8-quinolinolato)(3,5-di-tert-butyl phenolate) aluminum (III), Bis(2-methyl-4-ethyl-8-quinolinolato)(****-crezolate) aluminum (III), Bis(2-methyl-4-methoxy-8-quinolinolato)(para-phenylphenolate) aluminum (III), There are bis(2-methyl-5-cyano 8-quinolinolato)(alt. crezolate) aluminum (III), bis(2-methyl-6-trifluoromethyl 8-quinolinolato)(2-NAFUTORATO) aluminum (III), etc.

[0073]in addition, bis(2-methyl-8-quinolinolato)aluminum (III) -mu-oxo bis(2-methyl-8-quinolinolato) aluminum (III). bis(2,4-dimethyl- 8-quinolinolato)aluminum (III) -mu-oxo bis(2,4-dimethyl- 8-quinolinolato) aluminum (III). bis(4-ethyl-2-methyl-8-quinolinolato)aluminum (III) -mu-oxo bis(4-ethyl-2-methyl-8-quinolinolato)aluminum (III). bis(2-methyl-4-methoxy quinolinolato)aluminum (III) -mu-oxo bis(2-methyl-4-methoxy quinolinolato)aluminum (III). bis(5-cyano 2-methyl-8-quinolinolato)aluminum (III) -mu-oxo bis(5-cyano 2-methyl-8-quinolinolato)aluminum (III). bis(2-methyl-5-trifluoromethyl 8-quinolinolato)aluminum (III) -- it may be -mu-oxo bis(2-methyl-5-trifluoromethyl 8-quinolinolato)aluminum (III) etc.

[0074]As other host substances, the phenyl anthracene derivative of a Japanese Patent Application No. [No. 110569 / six to] statement, the tetra aryl ethene derivative of a Japanese Patent Application No. [No. 114456 / six to] statement, etc. are preferred.

[0075]A luminous layer may serve as an electron injection transporting bed, and, in such a case, it is preferred to use tris(8-quinolinolato) aluminum etc. What is necessary is just to vapor-deposit these fluorescence substances.

[0076]As for a luminous layer, it is also preferred to consider it as the mixed layer of at least one sort of hole pouring transportability compounds and at least one sort of electron injection transportability compounds if needed, and it is preferred to make a dopant contain in this mixed layer further. As for the content of the compound in such a mixed layer, it is preferred to consider it as further 0.1 - 15wt% 0.01 - 20wt%.

[0077]In a mixed layer, since each career moves very sexually in the inside of an advantageous substance since the hopping conduction path of a career is made, and reverse polar career pouring becomes difficult to take place, an organic compound becomes difficult to receive a damage and there is an advantage that an element life is extended. While being able to change the luminous wavelength characteristic which the

mixed layer itself has by making such a mixed layer contain the above-mentioned dopant and being able to make a luminous wavelength shift to long wavelength, luminescence intensity can be raised and the stability of an element can also be raised.

[0078]What is necessary is just to choose respectively the hole pouring transportability compound and electron injection transportability compound which are used for a mixed layer from the compound for the below-mentioned hole pouring transporting beds, and the compound for electron injection transporting beds. Especially, it is still more preferred to use the amine derivative which had strong fluorescence as a compound for hole pouring transporting beds, for example, the triphenyl diamine derivative which is hole carrying materials, and a styryl amine derivative and an amine derivative with an aromatic condensed ring.

[0079]As a compound of electron injection transportability, it is preferred to use a quinoline derivative, the metal complex which makes an eight quinolinol thru/or its derivative a ligand further, especially tris(8-quinolinolato) aluminum (Alq^3). It is also preferred to use the above-mentioned phenyl anthracene derivative and a tetra aryl ethene derivative.

[0080]It is still more preferred to use the amine derivative which had strong fluorescence as a compound for hole pouring transporting beds, for example, the triphenyl diamine derivative which is the above-mentioned hole carrying materials, and a styryl amine derivative and an amine derivative with an aromatic condensed ring.

[0081]Although the mixture ratio in this case is based on each carrier mobility and carrier concentration, Generally, the weight ratio of a compound which has the compound / electron injection transportation function of a hole pouring transportability compound is preferred to 1 / 99 – 99/1, and a pan, and it is preferred to make it 10 / 90 – 90/10, and become about 20 / 80 to 80/20 preferably especially.

[0082]The thickness of a mixed layer is more than the thickness equivalent to one layer of molecular layers, and it is preferred that less than the thickness of an organic compound layer carries out. It is preferred to specifically be referred to as 1–85 nm, and it is preferred to be especially referred to as 5–50 nm further 5–60 nm.

[0083]Although the vapor codeposition evaporated from a different deposition source as a formation method of a mixed layer is preferred, when steam pressure (evaporating temperature) is comparable or very near, it can be made to be able to mix within the same vacuum evaporation board beforehand, and can also vapor-deposit. Although it is more desirable for compounds to mix the mixed layer uniformly, depending on the case, a compound may exist in island shape. Generally, a luminous layer forms a luminous layer in predetermined thickness by vapor-depositing an organic fluorescent substance, or making it distribute in a resin binder, and coating.

[0084]In a hole pouring transporting bed, for example JP,63-295695,A, JP,2-191694,A, JP,3-792,A, JP,5-234681,A, The various organic compounds indicated in JP,5-239455,A, JP,5-299174,A, JP,7-126225,A, JP,7-126226,A, JP,8-100172,A, and EP0650955A1 grade can be used. For example, a tetra aryl BENJISHIN compound (doria reel diamine thru/or triphenyldiamine : TPD), They are the third class of aromatic amine, a hydrazone derivative, a carbazole derivative, a triazole derivative, an imidazole derivative, an oxadiazole derivative that has an amino group, a polythiophene, etc. These compounds may use two or more sorts together, using only one sort. What is necessary is to use a different layer, and just to laminate or mix, when using two or more sorts together.

[0085]When dividing a hole pouring transporting bed into a hole pouring layer and a hole transporting bed and ****(ing) it, desirable combination can be chosen and used out of the compound for hole pouring transporting beds. At this time, it is preferred to laminate in order of the small compound of ionization potential from the hole injection electrode sides (ITO etc.). It is preferred to use a filmy good compound for the hole injection electrode surface. About such laminating order, it is also the same as when providing a hole pouring transporting bed more than two-layer. By considering it as such laminating order, driver voltage can fall and generating of current leakage, and generating and growth of a dark spot can be prevented. Since vacuum evaporation is used and it can suppose that an about 1–10-nm thin film is also pinhole[homogeneity and]-free, when element-izing, Even if ionization potential is small in a hole pouring layer and it uses a compound which has absorption in a visible portion, decline in the efficiency by the tone change and resorption of the luminescent color can be prevented. A hole pouring transporting bed can be formed by vapor-depositing the above-mentioned compound like a luminous layer etc.

[0086]Quinoline derivatives, such as an organometallic complex which makes a ligand eight quinolinols, such as tris(8-quinolinolato) aluminum (Alq^3), or the derivative of those at an electron injection transporting bed, An oxadiazole derivative, a perylene derivative, a pyridine derivative, a pyrimidine derivative, a quinoxaline derivative, a diphenyl quinone derivative, a nitration fluorene derivative, etc. can be used. An electron injection transporting bed may serve as a luminous layer, and, in such a case, it is preferred to use tris(8-quinolinolato) aluminum etc. Formation of an electron injection transporting bed should just be based on vacuum evaporation etc. like a luminous layer.

[0087]When dividing an electron injection transporting bed into an electronic injection layer and an electron transport layer and laminating it, a desirable combination can be chosen and used out of the compound for electron injection transporting beds. At this time, it is preferred to laminate in order of a compound with a large value of electron affinity from the electron injection electrode side. About such laminating order, it is also the same as when providing an electron injection transporting bed more than two-layer.

[0088]It is preferred to use a vacuum deposition method for formation of a hole pouring transporting bed, a luminous layer, and an electron injection transporting bed, since a homogeneous thin film can be formed. When a vacuum deposition method is used, a homogeneous thin film of 0.1 micrometer or less is obtained for an amorphous state or a crystal grain diameter. If the crystal grain diameter is over 0.1 micrometer, it will become uneven luminescence, driver voltage of an element must be made high, and the injection efficiency of a hole will also fall remarkably.

[0089]As for an evaporation rate, although the conditions in particular of vacuum deposition are not limited, it is considered as the degree of vacuum below 10^{-4}Pa , and it is preferred to carry out in about 0.01–1nm/[sec and]. It is preferred to form each class continuously in a vacuum. Since it can prevent an impurity sticking to the interface of each class if it forms continuously in a vacuum, a high characteristic is acquired. Driver voltage of an element can be made low or generating and growth of a dark spot can be controlled.

[0090]When using a vacuum deposition method for formation of these each class and making one layer contain two or more compounds, it is preferred to carry out temperature control of each boat into which the compound was put individually, and to carry out vapor codeposition.

[0091]an organic EL device -- a direct-current drive -- a pulse drive is carried out and impressed electromotive force is usually about 2–30V.

[0092]

[Example]Hereafter, the concrete example of this invention is shown and this invention is explained still in detail.

As a <Example 1> auxiliary substrate, the most general pigment dispersion type light filter application process was given as the colorization technique of a liquid crystal display on the 1.1-mm-thick glass plate (Central Glass [Co., Ltd.] make: soda lime glass). It applied so that it might become the filter membrane thickness of 1.5–2.0 micrometers of each color, and it patterned. The application process of the light filter was performed as follows, when red was explained to the example. The spin coat of the light filter liquid for red was carried out for 5 seconds at 1000 rpm, and it prebaked for 3 minutes at 100 **. After irradiating with 20-mW ultraviolet rays for 30 seconds with an exposure machine, negatives were developed in the TMAH solution of concentration about 0.1%. Developing time was for about 1 minute. Then, the cure was carried out at 220 ** for 1 hour, and the predetermined red color filter pattern was completed so that it might not dissolve in another light filter liquid to apply.

[0093]Since other colors (green, blue) differ [materials (paints)], although it differs from the above-mentioned red color filter formation conditions in the details, they serve as almost same process. In this example, since manufacture is comparatively easy, use only the light filter, but. It is also possible for green and red to make it output by performing convert colors using a fluorescence conversion filter, and to also have composition of bright luminescence more and to have composition which is possible, laminates a light filter and a fluorescence conversion filter, and reconciles prevention of brightness lowering and improvement in color purity.

[0094]100 nm of ITO transparent electrodes (hole injection electrode) were separately formed in the sputtering technique on the glass substrate. With the technique of photo lithography, it patterned, and the etching process of the obtained ITO thin film was carried out, and it was used as the predetermined hole injection electrode pattern. aluminum and TiN were patterned as an auxiliary electrode. Then, as an

insulator layer, polyimide was applied to a thickness of 300 nm, was patterned, and the pattern of the hole injection electrode, the auxiliary electrode, and the insulator layer was obtained. It is made for the area of a color filter layer to become large to a picture element part, and the relation with the portion used as a color filter layer and the pixel of an ITO transparent electrode enabled it to secure the angle of visibility of 45 degrees at this time.

[0095] Subsequently, after UV/O₃-washing the surface, it fixed to the substrate holder of a vacuum evaporator, and the inside of a tub was decompressed below to 1×10^{-4} Pa. A 4,4',4''-tris(-N-(3-methylphenyl)-N-phenylamino) triphenylamine. Vapor-deposit (the following and m-MTDATA) in thickness of 40 nm by evaporation rate [of 0.2nm/sec] ., consider it as a hole pouring layer, and, subsequently the reduced pressure state has been maintained. N,N'-diphenyl-N,N'-m-tolyl 4,4'-diamino-1,1'-biphenyl (following, TPD) was vapor-deposited in thickness of 35 nm by evaporation rate [of 0.2nm/sec] ., and it was considered as the hole transporting bed. With decompression maintained, tris(8-quinolinolato) aluminum (the following, Alq3) was vapor-deposited in thickness of 50 nm by evaporation rate [of 0.2nm/sec] ., and it was considered as electron injection transportation and a luminous layer. Subsequently, with decompression maintained, this EL element structure board was moved from the vacuum evaporator to the sputter device, and the ALi electron injection electrode (Li concentration: 7.2at%) was formed in thickness of 50 nm by the sputtering pressure power of 1.0 Pa. As for supplied power, the size of 100W and a target made sputtering gas distance of 4 inch diameters, a substrate, and a target with 90 mm using Ar at that time. With decompression maintained, this EL element board was moved to other sputter devices, and aluminum protection electrode was formed in thickness of 200 nm by the sputtering pressure power of 0.3 Pa by DC sputtering technique using aluminum target. At this time, as for supplied power, the size of 500W and a target made sputtering gas distance of 4 inch diameters, a substrate, and a target with 90 mm using Ar.

[0096] The glass sealing plate was pasted together to the substrates face in which the obtained organic electroluminescence structure was formed using the adhesives for closure which mixed the glass bead spacer. As marking was doubled so that it might finally be in agreement with the picture element part of ITO in the auxiliary substrate obtained above, and the color filter layer forming face became the substrate side, it pasted together using adhesives. It turned out that the work (the work of the lamination of an auxiliary substrate is included) for this colorization can be done very easily compared with the conventional technique.

[0097] Direct current voltage was impressed in the atmosphere and the continuation drive of the obtained organic electroluminescence display was carried out by the constant current density of 10 mA/cm^2 . When the examination on visibility was done to 100 test subjects who extracted at random about this display, it answered that 79 persons were legible and it was answered that 21 persons did not understand. What answered that it was hard to see was not.

[0098] As a <Example 2> auxiliary substrate, pigment dispersion type resist was applied and patterned as a black matrix layer on the 1.1-mm-thick glass plate (Central Glass [Co., Ltd.] make: soda lime glass). The application process of the black matrix layer was performed as follows. The spin coat of the pigment dispersion type resist liquid was carried out for 5 seconds at 1000 rpm, and it prebaked for 3 minutes at 100 **. After irradiating with the ultraviolet rays of 20 mW for 60 seconds with an exposure machine, negatives were developed in the TMAH solution of concentration about 0.1%. Developing time was for about 2 minutes. Then, the cure was carried out at 220 ** for 1 hour, and the predetermined black matrix layer pattern was completed so that it might not dissolve in another light filter liquid to apply. The auxiliary substrate which does not provide a black matrix layer was prepared as a comparison sample.

[0099] After forming an organic electroluminescence structure like Example 1 on a glass substrate separately, the sealing plate was pasted up, the auxiliary substrate finally produced above was pasted together with the same technique as Example 1, and the organic electroluminescence display was obtained. It turned out that unification work (the work of the lamination of an auxiliary substrate is included) with this black matrix layer can be done very easily compared with the conventional technique.

[0100] Direct current voltage was impressed in the atmosphere and the continuation drive of the obtained organic electroluminescence display was carried out by the constant current density of 10 mA/cm^2 . When the examination on visibility was done to 100 test subjects who extracted at random, as compared with the

sample which does not form a black matrix layer, it answered that 86 persons were legible and it was answered that 14 persons did not understand. What answered that it was hard to see was not.

[0101]In <Example 3> example 1, the black matrix layer pattern of Example 2 was formed in the portion in which a color filter layer is not formed. It is made for the area of a picture element part to become large, and the area of a color filter layer enables it to secure the angle of visibility of 45 degrees, and it was made to become like drawing 3 and 4 in the relation between a black matrix and a picture element part at this time.

[0102]Others obtained the organic electroluminescence display like Example 1. The colorization in this case, the work of the black-matrix stratification, and the work of the lamination of an auxiliary substrate were also able to be done very easily compared with the former.

[0103]Direct current voltage was impressed in dry argon atmosphere, and the continuation drive of the obtained organic electroluminescence display was carried out by the constant current density of 10 mA/cm². When the examination on visibility was done to 100 test subjects who extracted at random, 91 persons answered that it was legible compared with the comparison sample, and answered that nine persons did not understand. What answered that it was hard to see was not.

[0104]An ITO transparent electrode is formed also in the field in which the auxiliary electrode on a substrate is formed, and it was made to become like drawing 5 in <Example 4> example 3. Others obtained the organic electroluminescence display like Example 3.

[0105]When visual observation of the obtained organic electroluminescence display is carried out from the auxiliary substrate side, the degree which shines silver as compared with the display produced in Example 3 decreases remarkably, and the whole looks black.

[0106]Direct current voltage was impressed in air mind, and the continuation drive of this display was carried out by the constant current density of 10 mA/cm². When the examination on visibility was done to 100 test subjects who extracted at random, it answered that 97 persons were more legible than the sample of Example 3, and it was answered that three persons did not understand. What answered that it was hard to see was not.

[0107]

[Effect of the Invention]As mentioned above, according to this invention, a complicated structure is not needed, but the work of manufacture, lamination, etc. is easy and the good organic electroluminescence color display of a contrast ratio can be provided by ** and low cost also without the damage to an organic electroluminescence structure.

[Translation done.]